Research on the Relationship between Lifestyle and Sleep Health

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Abstract. Insomnia, a widespread concern among the populace, frequently prompts questions about the determinants of sleep quality. Addressing these queries, the study meticulously examines the impact of various lifestyle factors on sleep. This paper utilizes a comprehensive dataset from Kaggle, encompassing an array of lifestyle habits and their corresponding sleep quality metrics. Through the application of a linear regression model and the robust bootstrap method, the analysis has brought to light a substantial scientific link between lifestyle choices and the quality of sleep. The findings are revealing: key factors such as age, the extent of physical activity, and the number of steps taken daily exhibit a positive correlation with enhanced sleep quality. In stark contrast, this paper observes that elevated stress levels and increased systolic blood pressure negatively impinge upon sleep. Intriguingly, the study further reveals that sleep quality is not uniform across the board; it varies significantly with gender differences and Body Mass Index (BMI) levels. These insights underscore the multifaceted nature of sleep quality, influenced by a tapestry of lifestyle elements. The research contributes to a deeper understanding of sleep dynamics, offering valuable perspectives for improving sleep health in the society.

Keywords: sleep health; sleep quality; lifestyle.

1. Introduction

Sleep, a fundamental human necessity, is as vital as food and water to maintain mental and physical well-being. In the modern whirlwind of life, sleep is often the first sacrifice at the altar of productivity-a dangerous precedent, as emerging research warns of grave consequences for such neglect. Sleep is a complex state of natural unconsciousness, critical for repairing and rejuvenating the body and mind. At the same time, ignoring sleep's importance can lead to dire impacts on our safety, mental acuity, and physical health, as well as increasing the risk of chronic diseases. Based on the existing environment, it is becoming increasingly apparent that we cannot afford to neglect the importance of sleep for our safety and mental and physical health, as the study indicates [1]. For another, sleep affects nearly every tissue in our bodies, influencing brain plasticity, immune function, disease resistance, and even the regulation of appetite, weight, and energy metabolism. Insufficient sleep—spanning all age groups—presents a significant risk factor for numerous health conditions, including cardiovascular disease, diabetes, and obesity. Inadequate sleep will considerably impact adults' health and increase the development and incidence rate of chronic diseases [2]. The pervasive underestimation of sleep's importance has resulted in a public health dilemma, where sleep deprivation is linked not just to medical concerns but to critical safety issues, given that a sleep-deprived individual behind the wheel or operating machinery is a hazard not just to themselves but to society at large.

The intricacies of sleep quality are influenced by an array of intrinsic and extrinsic factors. Positive emotions at work and a high priority for sleep can enhance sleep quality, promoting better health and productivity. However, the demands of cognitive workload and emotional stress, especially when experienced before bedtime, are potent disruptors of sleep architecture. Positive emotions and a high priority for sleep at work may enhance sleep quality, but pre-sleep arousal or cognitive and emotional demands may interfere with sleep cycles [3]. The role of employment is particularly influential, with

job quality significantly impacting sleep. Favorable job characteristics such as lower intensity, a positive environment, and meaningful work contribute to better sleep, suggesting that job satisfaction is inextricably linked to sleep satisfaction. The quality of work significantly impacts the quality of insomnia, playing different roles from different perspectives. A low work intensity, a good working environment, or a job that can give people a sense of achievement will lead to better sleep quality. Because sleep is an active process in the human body, it can help restore mental health and alleviate fatigue [4, 5]. Then, the labor market structure adds another layer of complexity. In the United States, a considerable segment of the workforce holds multiple jobs, leading to extended work hours and irregular schedules, detrimental to sleep quality and duration. In the United States, about 10% of those in employment hold several occupations. They are more prone to work irregular schedules and long hours, which are known to affect the quantity and quality of their sleep and raise the risk of injury [6]. This pattern of work-related sleep disruption is not isolated to the U.S. Still, it is echoed worldwide, with large-scale studies from various countries indicating that a significant portion of their populations suffer from insufficient sleep.

According to a survey, 29.9% of Americans receive fewer than six hours daily, with 40.5% of managers and business owners receiving less than six hours. Numerous large-scale studies conducted in Finland, Sweden, England, Korea, and Finland also show that many people operate on little or insufficient sleep [7]. The consequences of this global trend are evident, with many individuals reporting excessive sleepiness during the day, even falling asleep at work, which can have dire implications for personal and public safety. A report shows that 29% of Americans have fallen asleep at work in the past month [8]. At the same time, the focus on sleep as a health risk factor is well-deserved, with numerous studies demonstrating a clear link between sleep patterns and mortality rates. There is a strong correlation between sleep and mortality rate [9]. This emerging research has sparked a critical dialogue on the need for a public health paradigm shift, where sleep is accorded equal priority as diet and exercise. Sleep's essential role in cellular, organic, and systemic functions cannot be overstated-it is a cornerstone of health, with its absence being potentially harmful, affecting everything from feeding behavior and glucose regulation to blood pressure and cognitive processes. An organism's cellular, organic, and systemic activities depend on sleep, and its lack can harm one's health by altering blood pressure, glucose management, food habits, cognitive functions, and some hormonal axes [10].

In recognizing the profound impact of sleep on health, it is clear that a holistic approach is required to address the various factors that affect sleep quality. This includes individual behaviors, such as screen time before bed or diet, and broader societal issues, like work schedules and job demands. Interventions must be multifaceted and targeted to improve sleep quality and, by extension, overall health. This paper decided to research this subject to increase people's knowledge about sleep and its quality, and we hope it can raise people's awareness of the variety of factors that can affect the quality of their sleep.

2. Methods

2.1. Data Source

The dataset used in this study came from the Kaggle database, which contains nearly 400 observations on lifestyle and sleep health of people from different occupations. It collected 11 variables on lifestyle and sleep health. In this study sleep quality was used as a response variable and gender, age, occupation, physical activity level, stress level, BMI category, heart rate, daily steps and blood pressure were used as explanatory variables. Where blood pressure was further split into diastolic and systolic variables for analysis. So the final dataset that was used consisted of 12 variables, see Table 1.

Table 1. Introduction of 14 variables in dataset

Variables	Introduction	Type
Gender	The gender of the person (Male/Female)	Category
Age	The age of the person in years	Numeric
Occupation	The occupation or profession of the person	Category
Sleep Duration	The number of hours the person sleeps per day	Numeric
Quality of Sleep	A subjective rating of sleep quality, ranging from 1 to 10	Numeric
Physical.Activity.Level	The number of minutes per day that an individual engages in physical activity	Numeric
Stress.Level	A subjective rating of an individual's stress level, ranging from 1 to 10	Numeric
BMI.Category	The person's body mass index category (e.g., underweight(normal), normal weight, obese,overweight)	Category
Systolic	Pressure on the blood wall from the blood pressure in the blood vessels during heart contraction	Numeric
Diastolic	Pressure on the blood wall from the blood pressure in the blood vessels during diastole of the heart	Numeric
Heart Rate	A person's resting heart rate in beats per minute	Numeric
Daily Steps	The number of steps this person takes each day	Numeric

2.2. Methods Introduction

This paper dissects how lifestyle affects sleep quality through the use of bootstrapping to approximate sampling distributions as well as preliminary results using linear regression modeling. And before the analysis, the dataset used for modeling needed to be processed before the experiment started in order to get better results. In addition to normal data cleaning, some occupational categories were merged (sales representatives and salespeople were merged into the sales category, and engineers and software engineers were merged into the engineers category).

Bootstrapping was first used to approximate the distribution of sleep quality means across occupations. First, we analyze whether sleep quality is correlated with occupation. Here, we choose to simulate repeated sampling 1000 times. The final results are presented in the form of side-by-side box plots. And to ensure that our results are statistically significant, we further used ANOVA to analyze the differences between sleep quality across occupations.

This processed data was then continued to be used for model selection using the LASSO method to explore the relationship between sleep quality and lifestyle. The Lasso selection method requires that the dataset is first divided into two sub-datasets, the training subset (for model selection) and the test subset (for inference), where the training subset contains 60% of the observations in the total dataset in this experiment. Then, we need to run Lasso on the training subset to find out the lambda value that has the smallest cross-validation MSE value and then extract the lasso model coefficients that have the smallest MSE value in the Lasso model. In the results of this step, variables whose coefficients are not shown (in the form of dots) represent variables that need to be removed by lasso selection. Finally, the model is fitted using the remaining variables in the test subset.

3. Results and Discussion

3.1. Bootstrapping Results

Firstly the results based on bootstrapping. The figure 1 below shows the distribution of average sleep quality across occupations after 1000 repetitive samples:

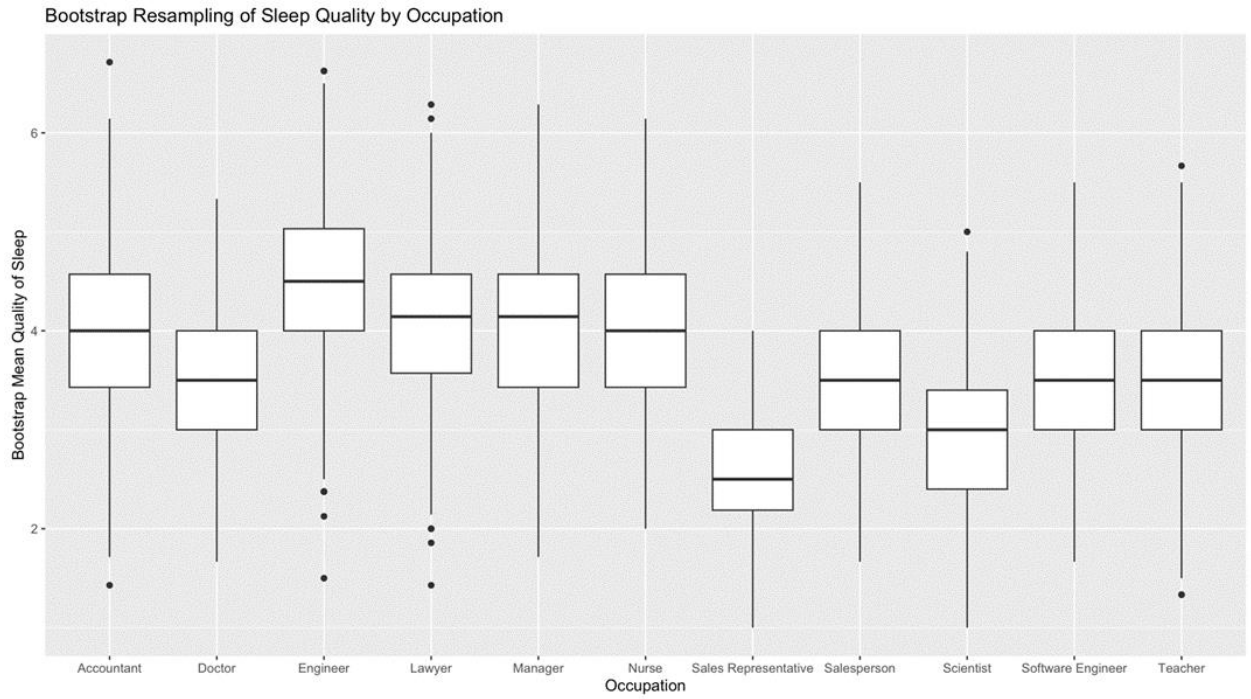

Fig. 1 Bootstrap Resampling of Sleep Quality by Occupation

By looking figure 1, we can see that there is no significant difference between the mean values of sleep quality for most occupations, which are clustered within the medium (4-5) interval range. Only the occupation of Sales Representative has a relatively low sleep quality mean. To confirm this finding. We further analyzed the data by ANOVA. The results obtained are as follows (Table 2):

Table 2. ANOVA of Different Occupation

	Df	Sum Sq	Mean Sq	F-value	Pr(>F)
Occupation	9	234.4	26.042	31.6	<2e-16
Residuals	364	300.0	0.824		

3.2. LASSO Selection and Regression Model

It is also easy to see from the results obtained from the ANOVA above that there is no statistically significant difference in the mean level of sleep quality according to occupation. So in order to further explore the relationship between sleep quality and lifestyle. In this study, a linear regression model will be fitted to hypothesize the relationship between the variables indicating lifestyle and sleep quality. First the lambda is selected by Cross-validation and the result of the selection is as follows (Figure 2):

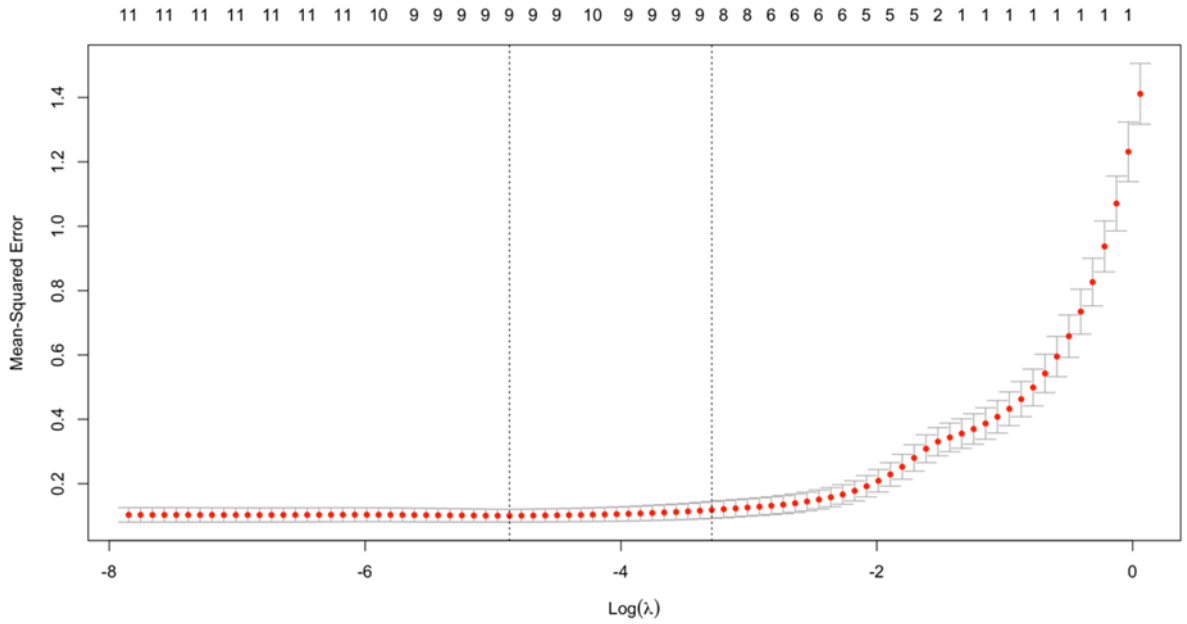

Fig. 2 Visualization of lambda

Table 3. Lambda from Cross-validation

	Lambda	Index	Measure	SE	Nonzeor
Min	0.008	54	0.100	0.020	9
1se	0.037	37	0.118	0.026	9

The above results (Table 3) show that both lambda.min (that is, lambda at the minimum of MSE) and lambda.1se (the mse is within one se of the minimum) remove two explanatory variables from the data. In order to get more accurate results, we chose to use lambda.min. And fit the selected variables to obtain a linear regression model for further analysis.

Table 4. Linear Regression Model

	Lambda	Index	Measure	SE
(Intercept)	9.44	0.587	16.1	9.99e-34
Age	0.073	0.005	13.4	8.12e-27
Physical.Activity.Level	0.006	0.002	2.87	4.74e-3
Stress.Level	-0.475	0.022	-21.9	3.28e-47
Daily.Steps	0.000	0.000	1.69	9.42e-2
Systolic	-0.0253	0.006	-4.29	3.34e-5
Gender_Male	0.392	0.065	6.05	1.27e-8
BMI.Category_Normal Weight	0.162	0.112	1.45	1.51e-1
BMI.Category_Obese	-0.705	0.193	-3.64	3.79e-4
BMI.Category_Overweight	-0.695	0.080	-8.70	8.00e-15

Based on the results shown in the table 4 above, it can be observed that most of the indicators are positively correlated with sleep quality. For example, age, level of physical activity, and number of steps per day are all positively correlated with sleep quality, and these correlations are scientifically significant. Stress level, on the other hand, is negatively correlated with the quality of sleep, as can be seen from the table above for every unit increase in stress level while keeping other variables constant. The quality of sleep decreases by 0.475 units. Systolic blood pressure also has a negative correlation on sleep quality while also keeping other variables constant. For every unit increase in systolic blood pressure, the level of sleep quality decreased by 0.0253 units. In addition to this, the

difference in gender also shows a different correlation with the quality of sleep when all other variables are kept constant, according to the table above, the quality of sleep of men is 0.392 units higher than that of women when all other variables are kept constant. Similarly, the following three data on BMI variables give similar results. The difference between the intercepts of the estimated regression for normal weight and normal is 0.162. However this result is not statistically significant (at 10%level). But for the other two BIM levels (Obese and Overweight), the estimated intercepts were scientifically significantly different from normal BMI. Holding other variables constant, the level of sleep quality at both levels of BMI was lower than the level of sleep quality at normal BMI.

3.3. Discussion

The findings above show that sleep quality is strongly related to most lifestyles. A team of researchers conducted a study in Guangzhou on the relationship between lifestyle and health self-assessment and the quality of sleep of residents. Similar results were obtained: the quality of sleep of male residents in Guangzhou was slightly better than that of women [11]. Another study on the relationship between sleep and lifestyle and sub-health found that sleep quality is closely related to life and health, and can even be used as a criterion for a healthy lifestyle [10]. All of these studies agree with the above results. These results show that age, physical activity level, and number of steps per day are positively correlated with sleep quality, while stress level and diastolic blood pressure are strongly negatively correlated with sleep quality. In addition, a healthier BMI (Normal weight) is also associated with better sleep quality than an unhealthy BMI (obese, overweight). This finding can be a reference for people who want to have a better quality of sleep. Sleep quality is important to people, but so is a healthy lifestyle.

Of course, there are many limitations to this research at this time. Since the data for the study in this article came from Kaggle, it does not cover a wide enough range of lifestyle variables. For example, daily diet, smoking status, etc. might have an impact on sleep quality. In addition, healthy physical condition may have an impact on both lifestyle and sleep quality, and the data used in this trial did not cover many physical condition indicators other than diastolic and venous blood pressure. This may lead to some confounding factors.

4. Conclusion

This research delves into the multifaceted factors contributing to poor sleep quality, a condition intricately linked to many causes. It offers a comprehensive reference for understanding the determinants of sleep, highlighting the integral role of healthy sleep in maintaining overall well-being. The study reveals a nuanced difference in sleep quality between genders, with men exhibiting marginally better sleep than women. Furthermore, the analysis uncovers that professional occupations play a significant role in influencing sleep quality. Individuals in high-stress careers, in particular, demonstrate varying degrees of sleep quality, suggesting the necessity for targeted strategies to enhance sleep among these groups. This study underscores the importance of adopting appropriate measures to improve sleep, especially for those facing significant occupational stress, contributing to healthier lifestyles and better sleep hygiene across different demographics.

Generally, there is a positive correlation between an individual's age, level of physical activity, daily step count, and sleep quality. Conversely, high-stress levels are significantly negatively correlated with diastolic blood pressure and sleep quality. Additionally, individuals with an unhealthy Body Mass Index (BMI) tend to experience comparatively poorer sleep quality. People need to pay more attention to what factors can affect their sleep quality so that those who want to improve their sleep quality can find the key to change. The author hopes that the research findings can provide guiding recommendations and contributions to this group of people who want to change their sleep quality.

Authors Contribution

All the authors contributed equally and their names were listed in alphabetical order.

References

[1] Worley, Susan L. The Extraordinary Importance of Sleep: The Detrimental Effects of Inadequate Sleep on Health and Public Safety Drive an Explosion of Sleep Research. A Peer-Reviewed Journal for Formulary Management, 2018.

[2] Marucci-Wellman H R, et al. Working Multiple Jobs over a Day or a Week: Short-Term Effects on Sleep Duration. Chronobiology International, 2016.

[3] Knudsen, Hannah K, et al. Job Stress and Poor Sleep Quality: Data from an American Sample of Full-Time Workers. Social Science & Medicine, 2007.

[4] Patel, Nirav P, et al. 'Sleep Disparity' in the Population: Poor Sleep Quality Is Strongly Associated with Poverty and Ethnicity. BioMed Central, 2010.

[5] Altun Insaf, et al. The Contributing Factors to Poor Sleep Experiences in According to the University Students: A Cross-Sectional Study. Journal of Research in Medical Sciences, 2012.

[6] Fang Y W. Study on the relationship between lifestyle such as exercise and health self-assessment and sleep quality of Guangzhou residents. Journal of Guangzhou Sports Institute, 2014.

[7] Juan Zhang, et al. Exploration of the relationship between sleep and lifestyle and subhealth. Health Care Guide, 2016, 6-6.

[8] Miao Jing, Che Yusan, Fang Die, et al. The correlation between sedentary behavior and sleep quality among primary and secondary school students. Chinese Journal of Mental Health, 2023, 37(9): 780-786.

[9] Chen Juan, Hu Jindou, Niu Linyan, et al. Research progress on the correlation between sedentary behavior and sleep disorders in the elderly. Gansu Medical Journal, 2023, 42(5): 402-405.

[10] Man Yingying, Xi Wei, Zhang Xin. The relationship between sleep time and lifestyle of children and adolescents in Tianjin. China Maternal and Child Health, 2016, 31(18): 5.

[11] Zhao Xiufa, Liu Yang, Li Chao, et al. The correlation between physical activity, sedentary behavior, and sleep problems in preschool children. Modern Preventive Medicine, 2022.